FINAL REPORT

DEVELOPMENT OF MARKETABLE NUTRACEUTICAL PRODUCTS USING SEA BUCKTHORN BERRIES

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COMPETITIVE MARKET ANALYSIS

OF

SEA BUCKTHORN IN SASKATCHEWAN

A Study prepared for the

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Indian Head, Saskatchewan

by

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CHAPTER 1

INTRODUCTION

1.1 Background

Although widely grown in parts of Europe and Asia sea buckthorn is new to North America. It is attracting interest as a new crop in Western Canada.

Sea buckthorn according to Schroeder and Yao is ideally suited to Saskatchewan's climate and soils. Research is being carried out by the PFRA at Indian Head, Saskatchewan to develop cultivars suited to Saskatchewan (Prairie) conditions and the technology to harvest it. Here the focus is on production. However if sea-buckthorn is to develop as a commercial crop markets must exist (or be developed) for its products.

Sea buckthorn produces a wide spectrum of products (components) that fit into the growing nutraceutical and health food markets. It has been used in both herbal and traditional medicines in Asia while in Europe it is used as a vitamin supplement, cosmetics, condiments and juice drinks. (Schroeder and Yao). In the Canadian market fruit juices and oil extracts are the main products being used from sea buckthorn. The seed produces an essential fatty acid that is relatively high in linolenic acid. However, the product has not been tested by the industry that produces omega 3 fatty acids. Sea buckthorn has high levels of Vitamins C and E, but again the market has not been assessed. There are additional products that can be extracted from the pulp of the fruit that have promise for the nutraceutical industry. These will be discussed further in Chapter 2 of the report.

1.2 Need for the Study

There is a growing movement in Saskatchewan and the other prairie provinces to diversify agriculture. This encompasses the search for new primary commodities to produce and for opportunities to create value added agri-food products. These products will have to generate prices sufficient to cover industry production, processing and marketing costs and return a profit to all vertical market segments of the industry.

While there is research being carried out on various aspects of production including cultivar selection and mechanical harvesting there has been limited public level research carried out on the markets for sea buckthorn products. Experience has shown that without an industry level feasibility analysis where all facets of the production and marketing systems and markets are assessed mistakes can be made. Not all crops and animals can be successfully and economically produced in Saskatchewan.

Information on marketing is critical to producer and processors of sea buckthorn. For example, producers ask these typical questions. If I produce sea buckthorn fruit (and leaves) can I find a buyer for it? What price will I be able to get, now and in the future? Will this price cover my operating costs, my fixed costs and provide a return in addition to my labour, my management and my investment? In other words will my sea buckthorn operation be profitable? For example, processors ask these questions. If I invest in a primary processing operation to process sea buckthorn fruit into its main derivatives (seed oil, pulp oil, juice etc.) where will I be able to sell it? What price will I get now and in the future? Will I be able to source good quality sea buckthorn fruit? What will I have to pay for the fruit? Will the supply of fruit be forthcoming each year and at the quality I require? Will I be able to cover my costs and make a profit?

The answer to these questions depends ultimately on the final consumer. In the case of sea buckthorn, markets will have to be created as sea buckthorn products are generally not known in North America. It may turn out that it could be easier to market sea buckthorn products in Asia and Europe where sea buckthorn is better known and used in cosmetics and health food products.

1.3 Purpose and Focus of Study

The overall purpose of the study is to investigate and quantify the market opportunities for a range of nutraceutical and functional food products that can be supplied from sea buckthorn. These products include essential oils, dermatological creams and ointments, health drinks, dehydrated fruit, fruit leathers, fruit granules, purees, and teas. Those market opportunities in large part will depend on the particular market segments in which sea buckthorn products can compete. It is important that those market segments have future growth potential.

Given time and resource limitations the primary focus of the study is the North American market, meaning Canada and the United States. This in some respects is unfortunate in that offshore markets might afford better market opportunities given that populations in Europe and Asia are likely to have more familiarity with sea buckthorn and herbal products.

The study attempts to determine the competitiveness of sea buckthorn products in comparison to similar products in the nutraceutical market. This task is difficult given that sea buckthorn products and derivatives have not been fully tested. The task is difficult because sea buckthorn is not well known in the nutraceutical and functional food industries in North America.

1.4 Approach to Study

The following is the approach that was taken to assess the market for the sea buckthorn products.

The standard approach for estimating the demand for any product (or commodity) is to gather data on the quantity of the product sold at various prices over a period of years and locations. Similar data on the prices of products that are deemed to be complements and substitutes are also obtained. Information is also obtained on household incomes. Econometric procedures are followed to obtain the coefficients that establish the specific relationships between quantity sold, prices and income.

The problem in estimating the demand for sea buckthorn products in North America is that there is no market data. The products have not been on the market sufficiently for the standard approach outlined above to be used. Thus an alternative methodology had to be developed. The following approach was followed.

Step 1. Classification of sea buckthorn components.

From the existing literature classify the main components of sea buckthorn that provide the ingredients for end-use products.

Step 2. Identification of end-use products from sea buckthorn

Identification of the range of end-use products that can be processed from sea buckthorn's primary components was based on the existing sea buckthorn literature.

Step 3. Identification of market segments

Identify the various market segments for which each of the end-use products from sea buckthorn. That is, the various primary components and end products for which sea buckthorn can be a substitute is determined. See Step 8 and discussion.

Step 4. Sales or manufactured data for production and/or market segments

Determine the current availability of data on the sales of products in each market segment. The sources will be (a) national or provincial (state) statistical units such as Statistics Canada or Agriculture and Agri-Food Canada. Another source is data collected by industry associations in Canada and the United States. Other sources would include public or private studies where surveys of retail (wholesale) firms or

manufacturing firms have been carried out. The final source is estimates (guesstimates) by industry experts, that is, people with industry experience.

Step 5. Industry structure.

Determine industry structure for sea buckthorn nutraceutical products. This will hopefully provide some insight into the competitiveness that exists in the industry. The key manufacturing firms will be identified, location, contacts etc.

Step 6. Interview key manufacturing firms

The main firms who are manufacturers of nutraceutical products for which sea buckthorn components (products) are substitutes will be interviewed to determine the demand (quantity and price) of these products. The knowledge these firms have of sea buckthorn will be determined. The means of accessing these firms (markets) will be determined.

Step 7. Estimate size and growth potential of each market segment

From Steps 4 and 6, estimate the size, and growth trend in each market segment where possible. Based on questions from firms make estimates of potential market shares for sea buckthorn components and products. This will provide the best estimate for markets for sea buckthorn products.

Step 8. Determine the feasibility of market entry for sea buckthorn and its components.

Economics will dictate whether sea buckthorn and its components will be able to penetrate a particular market. That is, working backward from a particular end-product use for a particular sea buckthorn component determine if it has the potential to compete for the market. This will depend on the unit cost of production of sea buckthorn berries (and other components such as leaves), and costs of transportation, storage, and processing. For example can the *B*-carotene in sea buckthorn fruit pulp oil compete with *B* -carotene from sources with high levels of *B*-carotene like carrots for the nutraceutical market? Can sea buckthorn oil compete with soybeans as a source of tocopherole where soybeans have approximately 1000 mg/1000 grams in comparison to sea buckthorn fruit pulp oil at 330 mg/1000g? Can sea buckthorn seed oil compete with other oils for antioxidants such as flaxoil, where flaxoil has about 50 percent linolenic acid and sea buckthorn in the 30 percent range?

Ideally Step 8 should be carried out first to determine which markets sea buckthorn has the potential to contest. If this were done it would make the study more efficient by eliminating market segments for which sea buckthorn might be considered based on its composition but where it has no economic possibilities for entry.

CHAPTER 2

PRODUCT AND MARKET SEGMENTS

The purpose of this chapter is to provide information first on the broader markets in which sea buckthorn products fit. It is important to establish the current and future growth in these markets. Second, is to outline the economical components that it produces, the chemical composition of its components, and the range of products that can be produced from these components. There is a short section that discusses consumer and market demand.

2.1 The Food and Neutraceutical Industries

Consumers in developed economies are becoming increasingly discriminating in their choice of what they eat. Food safety, health, the environment are all consumer issues that are increasingly affecting how food is produced, processed and marketed. Consumers want to know specifically what they are eating; therefore food labeling has become an important issue. GMO foods and thus biotechnology in general have raised the demand by consumers for food labeling.

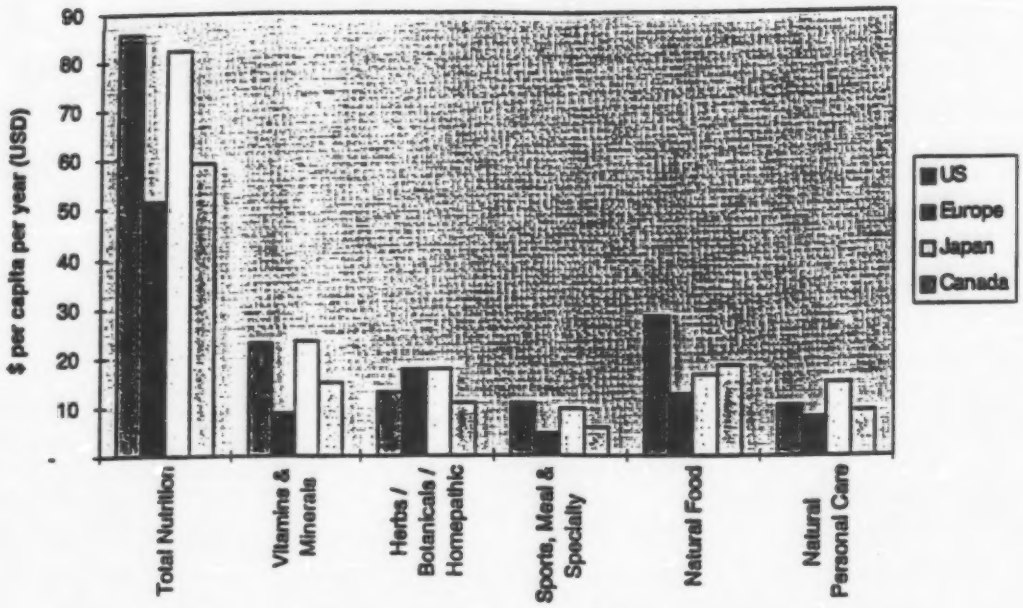
Consumers have become increasingly interested in natural substances that are deemed to improve on health, fitness, and mental state. A neutraceutical is a product that is credited with improving on general health and well-being. The market for neutraceuticals is now estimated to be in the billions of dollars in North America.

Consumers are also increasingly interested in appearance. The demands for substances that will enhance appearance, and offer protection have bolstered the cosmetic and toiletry industries. Frick reports that in 1989 the market for cosmetics in the United States was $1.6 billion and was expected to increase to $2.0 billion by 1995 (p.v)

The main markets for sea buckthorn products generally will fall into the nutraceutical and functional food industry. Health Canada has defined nutraceuticals and functional foods as follows. "A nutraceutical is a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food. A nutraceutical is demonstrated to have a physiological benefit or provide protection against chronic disease. A functional food is similar in appearance to, or may be, a conventional food, is consumed as part of a usual diet, and is demonstrated to have physiological benefits and, or reduce the risk of chronic disease beyond basic nutritional functions." (KPMG, 2000)

The Saskatchewan Nutraceutical Network (SNN) commissioned KPMG to undertake a study, as the title of the report suggests, to prepare a Master Strategy to Grow and Develop a Nutraceutical and Functional Foods Industry in Saskatchewan. Armand Lavoie, Clare Kirkland and Doug Bonderud carried out the study. It was completed in October 1999.

Section II of the KPMG report examines the market for nutraceutical and functional foods. The KPMG report is used here to provide information on the market for nutraceuticals and functional foods. This is contained in Section II of the report. Much of the information was taken from the Nutrition Business Journal (NBJ). The NBJ divides the broader market into five product categories: 1) vitamins and minerals, 2) herbs and botanicals, 3) sports, meal and specialty supplements, 4) natural foods, and 5) natural personal care. Sea buckthorn products can likely be found in all five categories. The product categories covered by the SNN are primarily categories 2, 3 and 5. These are the ones in which the KPMG study focused. SNN's mandate does not cover organic foods and only partially vitamins and minerals.



Source: KPMG, 1999

Figure 1: 1997 Consumption of Nutritional Product Categories by Region

The NBJ estimates global nutrition sales in 1998 at $71 billion US. Canada makes up only 3 percent of this market. Per capita consumption is highest in the US and Japan. Figure 2.1 provides information on per capita consumption for the five market categories.

"The nutritional market is seeing above normal growth compared to other more mature markets such as pharmaceuticals and conventional foods. The nutritional markets are anticipated to grow between 10 and 15 percent per year for the next three years while the conventional foods market are forecasted to grow 2 to 3 percent per year and pharmaceutical markets 5 to 6 percent . . . ." (KPMG, p.21)

The NBJ has provided estimates for the nutritional market for the US. This was contained in its Annual Industry Overview. It is shown in Table 2.1.

Table 2.1 1997 Growth Rates for Nutritional Market Segments in the US

Category	Market Size (million USD)	Forecasted Growth Rate
Vitamins	5,200	6-7%
Minerals	1,070	7-8%
Personal Care	2,790	6-10%
Herbs and Botanicals	3,530	16-18%
Specialty Supplements	906	14-16%
Meal Supplements	660	4-5%
Natural Foods	7,700	6-10%
Sports Supplements	1,270	6-8%

Source: NBJ Annual Industry Overview1998, KPMG, p.23

While Natural Foods market is the largest, however, it is the Herbs and Botanicals that is fastest growing at between 16-18 percent. While the overall industry is growing rapidly the rate of growth has been declining, the nutraceutical market, however, continues to grow at a faster pace than the general economy.

It is useful to briefly examine the distribution channels for nutraceutical and functional foods. These are broken down into 1) pharmacy, 2) stores that specialize in natural food, health food, health care and specialty, 3) supermarkets, large retail and discount stores, and 4) direct (internet, mail order, practitioner etc. The NBJ shows the sales channels for product categories (Table 2.2)

Table 2.2 1997 US Nutrition Industry: Products and Sales Channels' Consumer Sales (Millions USD)

	Sales Channels					
	Retail NF/HC	retail MM	mail order	multi level	pract-itioner	growth rate
Supplements	4,520	3,790	800	2,880	690	10-14%
Natural Foods	5,850	1,750	50	40	10	6-10%
Personal care	990	250	100	1,350	100	6-10%
Totals	11,360	5,790	950	4,270	800	
Growth	6-10%	12-16%	10-14%	4-6%	14-18%	

NBJ Annual Industry Overview1998, KPMG, p. 27

As the table shows the natural and health food stores are the main distribution channels but they are not growing as fast as the mass retail outlets. While a small percentage of the market outlets, the Internet is experiencing rapid growth. The Internet has certain advantages for nutritional products. It can provide consumers with product information on the health benefits of products, something that consumers are demanding. The Internet also provides a means for penetrating international markets. It also is convenient for consumers who do not have easy access to regular market channels.

What about the consumer? What does the consumer want (need) in terms of information? KPMG states that while the nutritional food market is growing," . . . growth is being limited by the inadequate information available on which and how much product to take, if it is safe, and if it works." According to the NBJ the most effective means of marketing tends to be by word-of-mouth, following by published research. The NBJ based on a survey of industry stakeholder groups showed that their research priorities were safety, standardization and efficacy of products. KPMG state that, "There is much concern about whether nutraceutical products actually contain active ingredients in the desired amount. Some companies are allegedly flooding the market with low-priced, sub-standard products". These products do not contain the amounts of bio-active ingredients indicated on the label, and as a result, lack efficacy and generally turn the public away form nutraceutical type products. "(KPMG, p. 32)

Consumers are also concerned about product safety, that is, the side effects from using the product. These concerns will result in increased research in order to assure consumers of product efficacy, and safety. This has implications for what firms are able to carry out this research. It would appear to favour large firms, with the resources to undergo this research along with clinical trials. Large firms also have the advantage in being able to patent their products, and protect their markets from new and smaller players.

2.2 Plant Description

Sea buckthorn (*Hippophae rhamnoides)* is a plant that is native to northern Europe and Asia. As explained by Schroeder and Nikolic "It is cold hardy and tolerates high soil pH and moderate salinity and grows well on most soils but prefers deep, loam soils in open sunlight. It tolerates drought, but not wetlands or poorly drained soils". They state for these reasons it is well adapted to the Canadian prairies.

Sea buckthorn plants are either male or female. In an orchard it is recommended (Schroeder and Nikolic) that 10 percent of the plants should be male for good pollination. Trees flower in May in Saskatchewan. Trees produce orange-red berries that ripen by the end of August but can remain on the tree throughout the winter.

Yield is a critical factor for the economics of sea buckthorn products. As stated by Schroeder and Nikolic "an average shrub produces 4 to 6 kilograms of fruit. One kilometer of shelterbelt with an equal number of male and female plants has a potential to yield 800 kilograms of fruit." A report on the Economics of Production assumes a berry yield of 5000 kg/acre taking into account harvesting loss. This was based on a ten-acre orchard with 3 feet by 9 feet spacing that requires 350 male and 1400 female plants.

Sea buckthorn fruit is different from most other fruit and berries. As explained by Rongsen it develops from an ovary and a calyx tube that is closely connected to the ovary. The fruit is a combination of an unsplit, fleshy, expanded, juicy calyx tube and an ovary. It is the juicy calyx tube that is of economic value. A parchment-like ovarian wall surrounds the seed. As Rongsen states, "Usually the seed is ovate-oblong with a length of 4 to 7 mm, a breadth of 2.5 to 3.5 mm and a thickness of 1.6 to 2.2 mm.

2.3 Chemical Components of Sea Buckthorn Fruits

The following table provides information on the chemical composition of sea buckthorn fruits.

Table 2.3 Chemical Components of Sea Buckthorn Fruits

Components	Content
Carotene and carotenoid	16-28 mg/100 g fruit
Flavonoid (fruit)	120-2100mg/100 g fruit
Flavonoid (leaf)	310-21--mg/100 g fruit
Volatile oil	3.6 mg/100 g fruit
Dry matter	24.6 - 33.8 %
Essential oil (seed)	8.0 - 12.0 %
Saturated fatty acid (fruit)	47.0%
Saturated fatty acid (seed)	21.0%
Unsaturated fatty acid (fruit)	53.0%
Unsaturated fatty acid (seed)	39.0%

Source: Li, T. S., Nutraceuticals in Sea Buckthorn,

2.4 Use Components from Sea Buckthorn

The following chart outlines the various uses from the different parts of sea buckthorn.

Bark	Pharmaceuticals Cosmetics			
Leaf	Pharmaceuticals Cosmetics Tea Animal feeds			
Fruits	Volatile Oil	Pharmaceuticals Drinks Food Products Cosmetics Flavours and		
	Juice	Sports drinks Health drinks		
	Pulp	Ternary juice	Food	Beverages Brewery
		Oil		Pharmaceuticals Cosmetics
		Residues		Animal feeds
Seeds	Oil	Pharmaceuticals Cosmetics		
	Residues	Animal Feeds		

Li, T. S. C., Nutraceuticals in Sea Buckthorn

The above chart does not provide information on the quantities or percentages of the various components. Although there is a sizable variation of sea buckthorn cultivars, which can be influenced by production conditions, it is useful to include this information.

An example of the fruit yield is as follows. Taking 1000 grams of fruit one would expect to obtain approximately 690 grams of pulp, 268 grams of juice and 42 grams of seed. The seeds would yield 5.9 grams of seed oil leaving 36.1 grams of seed hulls. The juice would yield 5.4 grams of oil and the pulp 20.7 grams of oil making 26.1 grams of pulp oil in total. This would leave 669.3 grams of pulp and 262.6 grams of juice.

The quantity of oil that can be extracted will vary depending on the method of extraction. Tom Li indicated that the oil yield from cold press is about 50 percent of hexane, that is 7-8 percent of cold press versus 14-15 percent for hexane. (Bill Schroeder, personal communication)

The overall moisture content of the fruit will vary but it should be approximately 80 percent. How this is split between the pulp and juice is not clear.

2.4.1 Juice

To begin with, according to Beveridge et al, individual fruits weigh between 270-480 mg and contain 73.6 to 85.3 percent moisture. Juice yields are normally about 67 percent using centrifugal procedures. "Juice may contain between 0.26 and 2.9 percent oil partially bound in the suspended pulp, and this oil promotes floating of a portion of the suspended solids while a second portion of suspended solids sinks to the bottom of the container providing a "three –phase" juice when the raw juice is allowed to stand beyond a few minutes." (Beveridge et al., p. 3842). It is the suspended solids that contain the carotenoid pigments, which can range from 9.4 to 34.5mg/100g.

Sea buckthorn is high in Vitamin C ranging from 360 to 2500 mg/100g of berries. In comparison orange juice contains between 35 to 56 mg/mL (Beveridge et al., p. 3482). Soluble sugars range from 9.3 to 22.7 Brix. There are 24 elements and trace elements. Beveridge et al. report from Harju and Ronkainen ". . . that the trace elements found in liqueurs prepared from sea buckthorn included Al, As, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Rb and Zn." There are also free amino acids the highest level being aspartic acid at 427 mg/100g (Beveridge et al, p 3843)

Preserving the juice is critical to marketing as there are reported limitations to shelf life. First Beveridge et al state that it is necessary to sterilize the juice that can be done by thermal treatment. Because the juice is "delicate" it is recommended that high temperature-short time (HTST) processes be used. This is necessary to preserve vitamin C and prevent loss of flavour and the development of off-flavour. In addition Beveridge et al. state " The juice was reported to turn brown after 6 months at 15-20 C, and thus browning was reduced under nonoxidative condition." (p. 3483). They state further that packaging should be considered that limits of eliminates contact of the juice with oxygen, as well low temperature distribution should be considered.

Beveridge et al in discussing juice products state that, "Freshly pressed juice is a complex mixture of fluid, suspended solids (cloud) and oil and is therefore a three-phase system that requires stabilization for most acceptable products." (p. 3483). They discuss the various problems associated with producing an acceptable juice for consumption. One of the problems is the characteristic flavour of sea buckthorn tends to be "whey-like" which is unpleasant to consumers. This can be offset by incubating the sea buckthorn macerate with acid rich fruit like apples, pears, strawberries etc. in the presence with potassium sorbate for 24 hours to 6 weeks. (Beveridge et al, p. 3484) Apparently the enzymes in the fruit degrade the flavour precursors that provide a flavour-improved product.

2.4.2 Powder

Powder is a product that can be made from the juice component of sea buckthorn. The powder results from first evaporating the water then pasteurizing the dried product. The pasteurized product is then spray dried to get the powder.

The nutrients in the powder should be the same as in the juice depending on the evaporation, pasteurization and spray drying process. As explained elsewhere in the study nutrients can be lost upon heating.

It is assumed that the powder can be used in cereal, baking, bars etc.

2.4.3 Pulp (Pomace)

The chart above shows the pulp as being used for animal feed. There is limited information on the nutrient composition in the literature.

2.4.4 Leaves

Beveridge et al report that that the leaves contain many nutrients and bioactive substances including flavonoids, carotenoids, free and esterified sterols, triterpenols, and isoprenols. Products include tea, tea powder and leaf extract as well as animal feed.

2.4.5 Oils

Sea buckthorn fruit produce two distinctive oils: from the seed and from the fruit pulp. In addition Bat and Tannert report that oil can be extracted from the pomace, "an oil which can in general be considered as a mixture of the fruit pulp and seed oil". (p.1) Table 2.4 contains the extraction information from both Quirin and Gerard, and Bat and Tannert.

Table 2.4 Fatty Acid Composition of Extracted Sea Buckthorn Fruit Pulp and Seed Oils

Fatty Acid	Fruit Pulp		Seed		Pomace
	percent				
	Q@G	B@T	Q@G	B@T	B@T
C10:0	-	-	-	-	-
C12:0	-	-	-	-	-
C14:0	0.4	0.2	-	-	0.1
C16.0	33.0	30.8	9.3	8.3	23.5
C10:1T	-	-	-	-	-
C16:1	-	-	1.7	0.6	-
C16.1C	32.9	35.6(C16:1) -	-	20.8	
C15:0	-	-	2.7	3.4	-
C18:1D9T	0.6	0.5	-	-	-
C18:1D11T	-	-	-	-	-
C18:1D6C	-	-	-	-	-
C18:1D9C	18.9	25.4(C18:1)	16.0	22.3(C18:1)	24.7(C18:1)
C18:1D11C	6.9		2.3	-	-
C18:2	-	5.5	36.2	33.0(C18:2)	14.8
C18:2TT	-		-	-	-
C18:2CC	5.4		-	-	-
C18:3	-	1.7	30.7	30.4(C18:3)	13.2
C20:0	-		0.3	0.9	0.3
C20:1	2.0	trace	-	0.2	0.3
C20:3	-		-	-	-
C20:4	-		-	-	-

Source: Quirin and Gerard and Bat and Tannert

Oil from fruit pulp

Quirin and Gerard report that they extracted oil from fruit pulp. This came from whole dried berries. They used an attrition mill to obtain the fruit pulp leaving the seeds untouched. The yield of the fruit pulp oil from the berries which they report came from Lithuania was 12.5 percent. To get the seed oil the sea buckthorn seeds were sifted out after obtaining the fruit pulp.

They report the process as follows: "1 tonne of expressed residue was dried, resulting in a weight reduction of 300 kg, the dried product was separated by means of air separation into 280 kg of sea buckthorn seeds and 220 kg of dried fruit pulp. The seeds were finely ground, yielding 22.5 kg of seed oil. This corresponds to a yield of 8 percent weight percent of the sea buckthorn seeds of 2.25 percent weight

percent of the processed fresh expressed residue."(p.5). Both the oils were extracted using CO2 at 320 bar and 45°C. [1]

The fruit pulp oil is semi-solid at room temperature. It becomes a clear liquid when heated to 30° C. They claim that the oil is very stable and for this reason it should be possible to deodorize it.

As shown in Table 2.4 the fruit pulp oil is high in palmitoleic acid (C16:1) at 33 percent.

The oil had a high carotene content (*B*- carotene) up to 0.21 percent. The material had orange-red colour but this could be reduced by lowering the solvent flow rate from 30 kg/kg of the berries to 20 kg/kg. This resulted in a standardized colour to 0.15 natural sea buckthorn carotene. This would thus no hinder the oils use in the preparation of cosmetics.

The literature makes numerous claims for the uses of the oil, as a sunscreen protective agent and an anti-oxidation agent.

Quirin and Gerard state that due to its physiological properties the oil is beneficial cosmetically in sunscreen preparations. They tested its potential filtering properties; the UV spectrum of fruit pulp oil was tested. The problem of sun burn (erythema) is in the UV-B spectrum. Quirin and Gerard state that in comparison to other oils sea buckthorn fruit pulp oil has good UV-B absorptive properties.

Quirin and Gerard state that, "it is also thought to have a biological protective effect. Antioxidants such as tocopherols and substances such as carotenoids acting as radical traps can reduce the UV-induced formation of toxic lipid peroxides and their daughter products in cells. Moreover, epithelizing and pain-soothing components contribute to the multiple effectiveness of sea buckthorn fruit pulp oil in sunscreen products." (p. 8)

Oil from the seed

The seed oil contains 36 percent linoleic acid (C18:2) and 31 percent linolenic (C18:3) In addition there was 9.3 percent palmitoleic acid (C16:1). It is thus made up of 95 percent unsaturated fatty acids. It has desirable properties for use as cosmetics, cosmeceuticals, and nutraceuticals. Sea buckthorn seed oil absorbs strongly in the UV-B range (290-320 nm) and may therefore be used as a natural sunscreen absorber." (Beveridge et al, p3486)

The high levels of alpha tocopherol could have health benefits as a natural antioxidant. Tocopherol is thought to minimize lipid oxidation, maintaining tissue integrity and thus reducing skin toughening and wrinkling according to Beveridge et al.

2.5 Consumer Demand

Consumer demand is largely determined by the need (want) that consumers have for a particular product, or category of products such, as food. "Need" is a very illusory term. In large part the need that consumers express for a particular product or commodity is based on the tastes and preferences and their goal to maximize their general satisfaction. It is also based on the knowledge that consumers have of the product, and the product's ability to satisfy the perceived set of needs.

In the case of foods, it has always been assumed that people realize that they cannot live without food, hence food would be the first claim on expenditure. What foods consumers choose to eat will depend on a wide set of factors. These factors include the knowledge of what one should eat in order to be healthy. Different foods have different constituents, proteins, fats, carbohydrates etc. Do consumers have knowledge of the types and levels of these constituents that are required and in what quantities? Next consumers need to know what specific foods and supplements can provide these constituents. This is a tall

[1] Bat and Tannert report that extraction is carried out using n-hexane but carbon dioxide extraction would be possible and advantageous.

order, but it seems clear that consumers have become much more health conscious and discriminating in what they are prepared to eat.

In addition to the product's attributes demand is largely determined by economics, the price of the product, price of substitutes and disposable income. It is not necessary to venture into the basics of economic theory on consumer demand, other than to say that food demand is usually assumed to be price inelastic. This means that the quantity of food that consumers purchase and consume is not largely sensitive to a change in price. However, the quantity purchased can often be quite sensitive to the price of similar products, which are seen to be highly substitutable. This can occur where products are very homogeneous or are perceived to be homogeneous.

Food is usually seen as income inelastic. This is especially true in developed economies where people are well fed. That is, as family disposable income increases they will not spend a large proportion of the increased income on food. The exception to this may be in the health food and nutraceutical market.

Some additional thoughts on consumer demand for health foods and nutraceuticals is outlined in chapter 3.

2.6 Market Demand

Market demand is derived from consumer demand. It can thus be seen as the summation of individual consumer demand in a particular market, which is usually seen in geographic terms. The size of the market thus depends on the population of that market. It is also affected by the percentage of the population that consume the particular product. For example the US market with about 290 million is about ten times the Canadian market of 30 million.

The percentage of the population that consumes a particular product will vary depending on the nature of the product. In assessing the trend in product demand it is important to know the changing percentage of consumers in that market. What percentage of the population for example consumes health food and nutraceutical products? Is there data on this and in particular data on specific products such as essential oils, health food juices etc.?

2.7 Product Adoption and Industry Development

Most consumer products have a particular life cyclical. That is, once it is introduced in the market consumers will assess the new product and determine to what degree it meets their needs and wants. If the product appears to be superior to an existing product for which the consumer is using, he/she may switch to the new product and try it. If it proves to be superior it will be adopted. The rate of adoption by the public at large will depend on how fast the merits of the new product spread. Word-of-mouth advertising is one means. Product advertising by the manufacturer and/or retailer will influence the rate of adoption.

The question for industry development is similar to that of product development and adoption. How does a new product "crowd itself into" a market that is currently occupied with similar products? How can a consumer product containing a sea buckthorn component capture market share? The first question is why would a manufacturer want to produce a product using a sea buckthorn component like seed or pulp oil, juice, powder etc.?

This same question must be posed at the primary production level. Specialty crops are those that farmers are trying to see if they can provide higher returns per acre than wheat and other established grains and oilseeds. Does the new crop have attributes that will allow it to enter the market, a process that can be referred to as "crowding in."? The reverse process is one of "crowding out." (Prentice and Storey, 1988). There are several crops in Western Canada for which this applies: oats, rye and flaxseed. All three of these crops experienced loss of acreage and production as farmers switched to other more profitable crops. Oat acreage declined when tractors replaced horses. Rye has declined as rye bread was replaced with wheat. Flaxseed declined when the demand for linseed oil for linoleum and paint manufacturing declined. Oats

and flaxseed have taken on a new life only because of the discovery of the health benefits of oat bran and linolenic fatty acid and lignin in flaxseed.

New specialty crops face many problems in getting established. One of the main problems is high marketing costs that includes high processing costs. New crops face higher risks as markets are thin, that is, there is lack of information for effective price discovery. Also thin markets usually imply few buyers. Although this does not necessarily result in forms of market collusion, or market manipulation, it makes this possible. There are usually higher risks associated with investment, investment in developing specialized infrastructure to market and process the commodity.

There can be lack of research funding (private and public) to effectively develop the commodity, to develop the management regimes, to investigate the market potential and to develop the final consumer products. The greater the number of specialty commodities that farmers are experimenting with the greater is this problem. It is not uncommon to find researchers working on a large number of different species of plants.

One of the key problems is information. New primary products like sea buckthorn suffer initially from lack of accurate information on the species itself in terms of its characteristics and composition. If there are large differences between cultivars in terms of ingredient composition the question becomes which cultivar is best? The question of best relates to what the market wants. What ingredients are most desired? That is, what do manufacturers want? In the case of sea buckthorn, is it vitamin C and E that is desired, or is it the percentage of oils, or is it the level of acidity, sugar content etc.? The industry can be set back if farmers plant the wrong cultivars (varieties). This is especially important for a perennial like sea buckthorn, or saskatoons, that can take years to develop and reach maturity.

The marketing literature stresses the required stages of adoption for a new product. The adoption process is one in which the consumer learns about the new product, tries it and develops a level of commitment to it. This process is similar for the adoption of a new technology. In the case of sea buckthorn both aspects are important.

The first stage is product awareness. Consumers become aware of a new product through advertisements, and discussions with other consumers who have tried the product. Farmers become aware of the new commodity in a similar manner. However, in the case of a new product like sea buckthorn, the initial information is likely to have resulted from some entrepreneurial effort in the private sector. It may have resulted from some public sector research activity by a government research unit.

The second stage is information search. This involves seeking out information about the product's characteristics by consumers. That is what are the benefits from using the product. In the case of food products, which affect health and safety, third party testing and labeling are important factors. Farmers considering planting the crop require agronomic and market information in order to determine if the crop is likely to be profitable. In the case of a perennial like sea buckthorn, the requirements are more critical. If I grow the commodity who will buy it? What price can I expect now and in the future? Will there be more than one buyer, that is, will I have some market protection through effective competition or will I face a "hold up" problem where there is only one buyer and that buyer is well aware that I have a sunk cost in my sea buckthorn orchard.

The third stage is product evaluation. In the case of a consumer product this may involve public testing. Has it been approved by a government agency like Food and Drug?

The fourth stage is the actual purchasing decision by the consumer or investment decision in the case of the farmer. For the consumer personal product evaluation will take place after the product has been purchased. For the farmer the buyer (or potential buyer) may have to offer some incentive (or assurance) for the farmer to invest in the new crop (enterprise).

The fifth and final stage is the consumer's post purchase evaluation. Repeat purchase is crucial for market development. If the initial consumers do not like the product then word-of-mouth negatives

about the product can destroy any potential the product may have had for success. This is why the first products to reach the market need to be of the highest possible quality. The problem for a new and emerging industry, it how to effectively regulates quality. How can the market be protected against a processor who produces an inferior product?

The next chapter attempts to assess the various markets for sea buckthorn. The ability to do that in large part, as explained above, depends on the level of awareness of sea buckthorn. If there is awareness because the firm is actually using sea buckthorn it depends on the willingness to depart with information. If there is no awareness, it will depend on the interest that potential users have in looking at information on sea buckthorn and providing even a cursory assessment of its demand in the absence of product testing.

CHAPTER 3

MARKETS FOR SEA BUCKTHORN

The purpose of this chapter is to provide an assessment for each market segment. These were discussed in Chapter 2. The identification of the various markets for which sea buckthorn products could fit is primarily based on the fragmented literature on sea buckthorn. The uses of sea buckthorn, as outlined in the literature is largely based on information on sea buckthorns use in China, Russia and northern Europe. The uses tend to fall into the following categories: cosmetics including sunscreen products, foods including juices, jams and syrups as well as nutraceuticals.

There have been few studies that have examined the markets for sea buckthorn products. If studies have been carried out they have been done by private sector firms and have been kept confidential. In some respects this is understandable where there may be competitive implications. The problem is that lack of good information on markets can hamper industry development and can in certain instances work against the very firms who are carefully guarding their studies.

Canada Sea Buckthorn Enterprises had a study carried out by Hartman and New Hope for certain segments of the market for sea buckthorn. They have generously agreed to share this market research. The following section reports the key aspects of the study.

3.1 US Consumer Use of Vitamins, Minerals and Herbal Supplements.

Two studies have been carried out for vitamins, minerals and herbal supplements for the US market. These are referred to as VMHS One: US Consumer Use for Vitamins, Minerals and Herbal Supplements. (not referenced). The study provided sample market projections for products with low incidence of use of US households. This study was conducted by Hartman and New Hope in 1997/98. The objective of Phase I of the study was "to determine the baseline demographics and usage by US consumer households of 25 vitamins and minerals, and 72 different herbal and supplement products." (Hartman and New Hope. p. 13)

The study was carried out by NFO Research. A mail survey was sent to 60,000 panel households that was drawn from a cross-sectional panel of 550,000 households selected "to conform to the latest available US census data for the nine geographical divisions and within each division by population density, age of homemaker, annual household income and household size." There were 43,442 surveys returned of which 29,611 contained household members who had used vitamins, minerals or supplements in the past six months, excluding use in cooking or food preparations

The results provide information on the percentage of household where a member used a particular vitamin, mineral or herbal supplement at least once in the previous six months. There is no information on the level of use, although one could speculate that if someone was using a particular supplement it would be regular usage as pertaining to that product.

One can assess the importance of this information as it pertains to sea buckthorn in terms of the use of a particular VMHS for which sea buckthorn has the capacity to provide. For example, 28.7 percent of all households returning the survey claimed to have used Vitamin C supplement (42.1percent of VHMS household users). A similar percentage used Vitamin E, 27.0 percent and 39.7 percent respectively. For Vitamin A use the percentages were 5.0 and 7.3. Sea buckthorn has high levels of these vitamins.

The most popular supplement used was garlic with 19.1 percent of all households using it and 28.1 percent of households that reported using a VMHS. The fifth most used supplement was Beta Carotene at 5.9 percent of all households and 8.7 percent of VMHS using households.

It is instructive to summarize how Hartman and New Hope made 10 year projections for three products, Kava Kava, Soy Isoflavones and Vitex /Chaste Berry. Kava Kava is used as the example. The study stated that there were 100,000 households in the US. In year one of the survey (1997) there were 0.6

percent of households using Kava Kava, which are 600.000 households. The average price for one purchase (no quantity was indicated) was $11.50. It was assumed that each household would make four purchases in the initial year. Based on these figures and assumptions the potential market for Kava Kava was estimated at $27,600,000US.

Hartman and New Hope next made projections of the number of households that would be using Kava Kava over the next 10 years. There was no explanation for how the projections were arrived at. The figures reveal that they assumed that growth would be 50 percent per year in the first few years declining to about 13 percent in the later years. The percentage of households using Kava Kava would increase from 0.6 percent to 8.5 percent by year 10. This would put it in 10 years where Ginseng and Ginkgo Biloba are in year one. Again there is no indication of the level of consumption of these two herbs ten years ago. How fast did their market grow?

The Hartman and New Hope study projected US households to grow to 116.3 million by year 10. They assumed household purchases of Kava Kava would increase from four units in year one to 6 in year 10. With increased demand the average retail price was assumed to decline from $11.50 to $8.00. This would give a projected market potential for Kava Kava of $474.8 million US. This is almost a 20-fold increase in sales.

For Soy Isoflavones the study projected the market potential to grow from $4.2 million US to $194.6 million US by year 10. This is almost a 45-fold increase in sales. For Vitex/Chaste Berry they projected the market potential to increase from $2 million US to $228.1 million US over a 100-fold increase.

Hartman and New Hope are very optimistic for these three herb supplements. Their study made projections for sea buckthorn tea but no other sea buckthorn product. However, given that the study has information on essential fatty acids and vitamins and minerals this can be used to make some assessment for sea buckthorn. The problem is that this type of analysis is based on assumptions that must be taken as highly speculative. One should, however, not take dismiss this analysis for the simple reason that it can provide useful insights for potential markets. In addition it is the best that seems to be currently available.

3.2 The Beverage Market

The beverage market is assumed to include products from sea buckthorn, which are generally consumed as drinks. This includes juices and teas.

3.2.1 The General Beverage Market

This section examines the beverage market that includes juices and products such as teas, etc. It is not clear where sea buckthorn products will eventually fit; however, it is likely that they will primarily have to penetrate the health (nutritional) and sports market segment. The section first examines the trend in the Canadian overall juice market. It then turns to what is known about the nutraceutical market for beverages. The latter is based first on literature from the non-academic journals, the Internet and selected interviews with companies who produce juices targeting the health market.

In Canada fruit juice consumption in Canada has increased four times in the period 1965 to 1996, that is, 400 percent. It has been one of the fastest growing market components of Canadian's diet. Overall fruit consumption in all forms has been the fastest growing component of all major food groups. Table 3.1provides data for the period 1965 to 1996. It shows that overall consumption in fresh fruit equivalent has increased by 46 percent from 1965 to 1996. The average consumption for the 10 years 1961 to 1970 was 83.93 kg; therefore 1965 consumption of 83.40 kg was typical of that period. Total consumption actually peaked in 1994 at 123.29 kg. By comparison vegetable consumption increased by 35 percent for the same period and oils and fats by 44 percent. Cereals consumption increased by 5 percent.

While fruit juice consumption has increased vegetable juice consumption, while never high, has declined. Per capita vegetable juice disappearance was 4.57 litres in 1961, 3.62 litres in 1981, 2.05 litres in 1991 and 1.86 litres in 1998.

Table 3.1 Per Capita Disappearance of Fruits in Canada, 1965 to 1998

Year	Fresh	Processed			Juice	Total*
		Canned	Frozen	Dried		
			kg		litres	kg
1965	50.80	8.58	1.69	1.61	6.74	83.40
1970	52.28	7.05	1.50	1.28	8.67	84.72
1975	56.09	6.20	1.23	1.16	14.03	96.59
1980	56.42	5.57	1.35	1,47	21,34	110.85
1985	58.93	5.15	1.36	1.37	21.59	111.53
1990	61.15	4.52	1.55	1.47	23.35	114.41
1994	65.43	4.06	1.76	1.32	25.58	123.29
1995	63.85	4.08	1.78	1.32	25.96	122.80
1996	61.95	3.63	1.58	1.37	26.54	121.66
1998	64.19				24.73	121.32

Statistics Canada, Cat No. 32-230 XPD
* In fresh equivalent weight

To put fruit juices in perspective it is instructive to look at per capita disappearance of other liquids. In 1998 Canadians consumed 88.50 litres of milk, 117.00 litres of soft drinks and 79.55 litres of alcohol. Between 1961 and 1981 both milk and alcohol consumption increased, alcohol 53 percent and milk consumption 21 percent. Over the last 20 years, since 1981 milk consumption has declined 13 percent, and alcohol consumption 21 percent. Between 1981 and 1998 soft drink consumption increased by 73 percent. In the same period fruit juice consumption has remained static.

Table 3.2 provides a breakdown on fruit juice consumption by type of fruit. Orange juice dominates with 52 percent, followed by apple juice at 25 percent. Apple juice consumption has fallen while grape and orange juices have increased. Tomato juice, which stood at 2.77 litres per capita in 1986, has fallen to 1.86 litres in 1998.

Table 3.2 Per Capita Consumption of Fruit Juices by Type of Fruit, Canada

Year	apple	grape	grape Fruit	orange	pine apple	total
1986	9.14	1.73	0.84	11.72	0.29	23.72
1998	6.14	4.10	0.72	12.79	0.64	24.39

Source: Statistics Canada, Food Consumption in Canada

It is difficult to predict what share of the general juice market sea buckthorn could capture. If it were only to capture 1 percent of the current market (i.e. 1996) with 30 million Canadians this would amount to almost 8 million litres of juice. Five percent would be 40 million litres. In her paper on Sweden Wahlberg took 5 percent as a "suppose" example. Much of the literature on sea buckthorn suggests that the North American juice market is likely to be one of the easiest markets to penetrate. This is also the opinion of Katarina Wahlberg where she was assessing the market prospects for sea buckthorn in Sweden. She stated that "My opinion is that the easiest way to enter the Swedish market is with sea buckthorn juice" (Wahlberg, p. 26)

One must be careful in assuming that sea buckthorn could contest the general juice market. What is the juice market? What juices tend to dominate the market and why? I believe the simply answer is economics. Given the yields of products like apples, oranges and grapefruit it is hard to envision sea buckthorn pulp juice being competitive in the general juice market. Hilary Rodrigues who is entering into the processing of sea buckthorn (see case section 3.5) feels that sea buckthorn can directly challenge in the general juice market.

The Economics of Sea Buckthorn in comparison to orange juice

The purpose here is to provide a cursory analysis of the economics of juice from sea buckthorn in comparison to orange juice. The comparison is made by first taking the yield of orange juice per acre in Florida and determining its market value. This is compared to the per acre yield of sea buckthorn juice per acre.

The estimated yield of oranges for 1999/00 in Florida is 387 boxes per acre. In 1998/99 the yield was 304 boxes. A box of oranges weighs 90 pounds. For 1999/00 it has been estimated that one box will yield 1.55 gallons (US) at 42degrees BRIX. In order to get the single strength equivalent the adjustment factor is 4.039. That is the yield in single strength is estimated at 6.26 gallons per box. This works out to a juice yield per acre of 2,422.6 gallons. Assuming that orange juice has a similar weight to water this is equivalent to 19,380 pounds of juice per acre.

For sea buckthorn it is assumed that the yield will be five tonnes per acre of fresh berries. It is next assumed that there is approximately 268 grams of juice in 1000 grams of fresh berries, or 26.8 percent juice. The juice yield would therefore be 1.34 tonnes per acre, which is 2,950 pounds.

Based on these assumptions and analysis sea buckthorn can produce only approximately one-sixth of the juice that an acre of oranges can produce. This, however, does not mean that sea buckthorn cannot compete directly with orange juice in the main juice market. The cost of producing and processing oranges into juice and sea buckthorn must be taken into account. In addition sea buckthorn produces other products whose value must be included.

The price of oranges was at $2.62 per box in November 2000. The comparable figure was $3.68 per box in November 1998/99. This is the price of oranges on the tree. The cost of harvesting and hauling is approximately $1.80 to $1.90 per box. The processing cost was estimated by one Florida economist at $0.25 and another economist at $0.15 per gallon. The Economic and Market Research Report of the

Florida Department of Citrus using AC Nielsen Scantrack figures show the retail value of orange juice ranged between $4.31 to $4.37 dollars per gallon for the period 11/27/99 and 11/25/00.

As shown above five tonnes per acre of sea buckthorn fruit would produce approximately 2,950 pounds of juice, or 370 US gallons. If sea buckthorn could be marketed at the same price as orange juice, say $4.35 per gallon, this would mean $161 US per acre, or about $240 Cdn. It is not clear if sea buckthorn juice could be sold at a premium. The return to the sea buckthorn producer would less, by the cost of marketing and processing.

3.2.2 The Nutraceutical/Functional Food Beverage Market

Based on SPINS, the functional beverage market in the US expanded from $1.05 billion to $1.17 billion between May 1999 to May 2000. This is a growth of 11.3 percent. This comprises meal replacement beverages, lifestyle and wellness beverages, medicinal teas and isotonic beverages. This market can be broken down as follows: meal replacement (77%), lifestyle-wellness (14%), medicinal teas (9%) and isotonic beverages (0.5%). (ACNeilson/SPINS).

Bajeerah Lowe reports in an article "Booming Beverages" in Nutritional Outlook, September 2000, that the functional food and beverage market sales in the US were an estimated $6 billion in 1999 and expected to grow to $10.9 billion by 2004. This was based on a study done by Business Communications Co. Inc. of Norwalk, Connecticut. Of this, the study estimated that 78 percent to be functional beverages.

What is precipitating this growth? The author quotes Angela Yervasi, director of sales, of Bio-Botanica as saying that it offers consumers a great way to receive herbal support on-the-run. She also quotes Michael Cornell who is business manager of Seltzer Chemicals Inc. of California who says, "The success of functional beverages lies in the desire of baby boomers to maintain a healthy lifestyle and their ability to self treat themselves." In other words the demand is based on a interest to be healthy and convenience.

What are the product requirements? All the articles surveyed stressed the importance of quality in terms of taste, and benefits. The author quotes Cornell as saying that many vitamins and botanical extracts have unfamiliar or unpleasant tastes and some have objectionable colours. Some extracts react adversely with other ingredients. Cornell states that, in developing a fortified beverage, particular attention needs to be made concerning the degradation and possible adverse ingredient interaction between the functional ingredients, and the processing temperature, the pH of the beverage, the ingredients used in the flavor profile and even the packaging used for the product." Other industry personnel stress the importance of flavour—it must taste good because they won't buy it just for its functional benefits.

What ingredients are consumers looking for? This will be critical to sea buckthorn's ability to establish a niche demand in the health beverage market. Bajeerah Lowe quotes Ram Chaudhari, senior executive of Fortitech, as saying that some of the popular ingredients used in beverages include antioxidants such as Vitamins C and E, zinc, L-carnititn, taurine and selenium. In addition other industry personal point to omega-3 fatty acids and calcium as popular beverage ingredients.

There are indications that consumers wanted a beverage that was low in calories, carbohydrates and caffeine. Based on this observation Aloe Splash Inc. of Chandler, Arizona created Aloe Splash, which apparently meets these requirements and adding aloe vera juice plus Vitamin C. If correct this should benefit sea buckthorn given its high levels of Vitamin C and E.

What about teas? The literature points to research that points to the benefits of teas in reducing heart attack risk and risk of severe aortic arteriosclerosis. Most of the literature talks about green and black teas. How does sea buckthorn leaves to make tea stack up with green and black teas? How do they differ?

In addition there is suggestions that green tea is known for its antioxidant properties in reducing the effects of premature aging, in promoting cardiovascular and gastrointestinal health as well as dental

and periodontal health. Bajeerah quotes Gerry Kiernan vice president of Takeda as saying, "We are looking for the beverage industry to develop to take the necessary step to developing second generation forms of traditional athletic beverages like Gatorade and Powerade containing a full range of antioxidants (such as green tea extract, vitamin C and vitamin E) . . ." He, however, questions whether the market is ready to accept this type of beverage.

There are companies like TeaTech a division of Xel Herbacueurticals of Salt Lake city that will begin to offer teas with high concentrations of polyphenols an other beneficial ingredients from green tea leaves. For example the company claims that one serving contains 150-300 mg of polyphenols whereas a conventional tea bag might contain 30-60 mgs of polyphenols.

As discussed in Chapter 2 there are concerns being raised over the validity of the claims being made for the health benefits of various products. In a recent article in FOOD Technology, November 2000 Pierce Hollingworth raises a series of questions regarding the what is the truth about the claimed benefits of adding vitamins, herbs and minerals. He points out that the market in the US for all noncarbonated drinks was $13 billion in 1999. He says that "Because of the relatively low barrier to entry, regional bottlers are introducing virtually overnight herbal-laced, exotic soft drinks and juices aimed at niche markets. He says the trend is global. He states, "This runaway freight train may be facing some rough tracks, however. The frenzied growth to the category is based largely on the implicit-and increasingly explicit -health claims associated with these beverages." "To date, functional beverage marketers have enjoyed considerable latitude in making health claims because of the provision of the Dietary Supplement Health and Education Act of 1994. The law gives dietary supplement manufacturers freedom to provide information of the product's benefits.

The use of these supplements in beverages falls into the category as GRAS. He says the escalating popularity of functional beverages has led to a call for tighter review and approved procedures. "Last summer the Center of Science in the Public Interest (CSPI) predictably called on the FDA to halt sales of most functional beverages containing herbs such as St. John's wort, Echinacea, ginkgo biloba, and kava kava." The bottom line is that the functional beverage industry and quite likely the entire nutraceutical industry will face increasing pressure for regulation. He concludes that the industry will continue to expand and but could face greater regulation if companies start making excessive health claims.

3.3 The Market for Sea Buckthorn Tea

Leaves from sea buckthorn can be used to produce a number of products such as tea, tea extracts, sea powder and animal feed. Beveridge et al report that, "Sea buckthorn leaves contain many nutrient and bioactive substances." (1999) They quote a study by Chen et al in 1991 that reported flavonoid content in the leaves range from 319 to 2100 mg/100 grams (0.3 to 2.1%) of air-dried leaves. They quote a study in 1996 by Goncharova and Glushenkova which reported that sea buckthorn leaves were rich in carotenoids, free and sterified sterols, tirterpenols, and isoprenols.

Flavonoids appear in many citrus fruits, gingko etc. and have been used by various cultures historically. There is a growing interest in the therapeutic potential of flavonoids. The biological benefits have included anti-inflammatory, anti-oxidative, anti-viral, adaptogenic, anti-tumor and immunostimulatory. (Barl and Dunlop, October 2000, {Progress Report)

Barl and Dunlop analyzed the flavonoid content of sea buckthorn leaves and fruit samples provided by PFRA in Indian Head. Briefly the results showed that "Flavonoid content, expressed as isorhamnetin equivalents, was in the range of 0.95% - 2.0% for leaves . . ." This result matches closely to the results reported in the earlier literature, as outlined above.

The Hartman and New Hope study included information on the "predicted US herbal tea market size, which included functional and nutritional teas. The source of this information was Sage Tea Report, 1997. This particular report predicted wholesale dollar sales of $230 million in 1995 increasing to $385 million by 2001.

Hartman and New Hope provided, as they refer to it, sample market projections for a sea buckthorn tea. They state in their assumptions that, "Initial tea projection are based on 13% of US VMHS Users who stated that they preferred tea as an herbal delivery format, as asked in VMHS II, a nationally representative study of US consumers." This provided a base of 8,840,000 households as an initial market size. In year one of their projection they assumed two purchases per year and a average tea price of $2.50. This resulted in a market size estimate of $2.2 million US. In year 10 they projected that there would be 13.7 million households consuming sea buckthorn tea. They further assumed that each household would be purchasing 4 units per year at a lower price of $2.10. This resulted in a market size of $18.4 million US.

If year one is 1998 of the sea buckthorn market projection $2.2 million in sales of sea buckthorn would represent less than one percent of the $290 million market for herbal teas as estimated by the Sage Tea Report.

How many acres of sea buckthorn would it take to produce the amount of leaves for a market of this size in the US? It will be assumed that a typical sea buckthorn orchard consists of spacing of 3 by 16.5 feet. This results in 735 plants per acre of which one out of seven are male plants-105 males and 630 females. It is further assumed that leaves are only taken from the male plants, as defoliating the female plants would reduce berry yield on the female plants. The leaves would be harvested in July. The outer leaves would be taken. About 70 percent of the total leaves being harvested. [2]

How many leaves are required to make a standard package of sea buckthorn tea? What did Hartman and New Hope assume made up a package? There was no information provided in their report.

3.4 The Market for Essential Fatty Acids

The majority of fatty acids that the body requires are obtained from the diet. The lipid biosynthetic capacity of the body can supply the body with all the various fatty acid structures that are needed with two key exceptions: the linoleic and linlenic fatty acids. These cannot be synthesized from precursors in the body. These two fatty acids are therefore considered as "essential fatty acids" because they must be obtained from the diet.

There is a growing market for oils for direct human consumption that are rich in omega-3 fatty acids. In modern societies the trend has been toward an increase in saturated fatty acids and especially omega-6 fatty acids found in vegetable oils and animal fat. Omega-3 fatty acids are known to be essential for infant growth and development and to protect against heart disease, thrombosis, hypertension and inflammatory and autoimmune disorders."(Simopoulos) The Food and Nutrition Board of the US National Research Council recommends that Omega-3 fatty acid intake should be 10-25 percent of that of linoleic acid or about 0.2-0.5 percent of total energy. (Food and Nutrition Board). Health Canada has a recommended nutrition intake for essential fatty acids (EFAs) of a minimum daily intake of 3 percent of total energy omega-6 fatty acids as linoleic and 0.5 percent of total energy of omega-3 fatty acids as alpha-linolenic acid (Scientific Review Committee)

According to Simopoulos the current dietary ratio of n-6/n-3 fatty acids ranges from 10.1 to 25:1. Health Canada recommends a ratio of 4:1 to 10:1. In addition FAO/WHO recommends a ratio of 5:1 to 10:1.

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[2] There does not seem to be any good estimate of the quantity of leaves that can be harvested from a mature male plant. The budgets for sea buckthorn fruit and leaf production as provided by PFRA Shelterbelt Centre show "leaves harvested to range from 200-700 kgs/acre selective." This budget was based on plant spacing of 3 by 9 feet which is much less than what would be necessary for machine harvesting. Plant spacing of 3 by 16.5 feet, which would be suitable for machine harvesting, would result in 735 plants per acre of which 105 would be male.

The main sources of omega-3 fatty acids are green leafy vegetables, legumes and seafood. However, one of the best sources is flaxseed oil, which contains about 50 percent linolenic fatty acid. Flaxseed oil contains three times as much omega-3 as omega-6 fatty acids. Flaxseed oil has a n-6/n-3 ratio of 3:1. In comparison the ratio for soybean oil is 7:1 and canola oil is 2:1.

Several companies producing oils for the health food market were contacted. These included; Omega Nutrition of Canada Inc., Flora Distributors Ltd., Gold Top Organics, Spectrum Natural, Barleans, Bioiginal and Science Corp. (see references for further details). In addition to obtaining information on the market for flax and other oils each company was asked to assess sea buckthorn oils for their potential use in this particular market. Information on sea buckthorn oil was sent to each company. This was followed by a discussion

Gold Top Organics, Edmonton Alberta.

This company has been processing organic oils for 15 years. They cold press flax seed, hemp, borage, sesame, sunflower and pumpkin. Flaxoil constitutes 80 of their total production. Hemp oil is the main competitor for flax oil. Gold Top's market is primarily in Canada with five percent being international. Their market is mainly through health food stores.

They estimate that the market for flax oil has grown by about five percent per year. This growth has tended to push price down and also the margin.

On the first contact the President stated that he had heard of sea buckthorn oils but had not tested them and knew very little about them. He expressed an interest in knowing more about them and was interested in obtaining a sample of oil and fruit for testing.

I asked what information on he would require in order to assess Sea Buckthorn oils. He would need information on the oil's fatty acid profile, how it reacts in storage, its moisture content, and the yield from the raw commodity. He said the product would have to be organic.

He would not provide me information on his sales.

Barleans, Washington State

Sent information on seed oil. Did not hear from them.

Biooriginal, Saskatoon

They did an assessment of sea buckthorn but are currently not interested in pursuing it, largely because of the price of sea buckthorn oil in relation to other oils.

Spectrum Natural, California

When first contacted the company referred me to Reece Moreman who they use as their expert on oils. Reese Moreman is a private marketing consultant. He tends to specialize in markets for essential fatty acids. He says he was instrumental in developing the North American market for flaxseed oil. In fact he said that it was he "that put flax oil on the map." He says he has worked with Bruce McDonald and the Flax Council of Canada. He is a Canadian Spectrum Naturals uses him as their oils consultant.

He said that he was familiar with sea buckthorn seed oil. He looked at it about four years ago for a co-op group in Manitoba. He said that as far as he could tell the seed oil had no "startling properties" that would give it some advantage in the EFA market. He said the bad news is that unless sea buckthorn is processed correctly the oil will not be stable. He did not say that this could not be done. He said that the cost for a cold press modified atmosphere extractor is approximately one million dollars US. A operation of this cost would process 4-5 million pounds of flaxseed. He said further that using CO2 would not produce a stable oil.

His final assessment was that there may be some value in the trace components of the seed oil but without additional work and information he would not know what these may be. There was some discussion of Vitamin E. He said that soybeans currently provide the market needs for Vitamin E.

3.4.1 Size of Market for Essential Fatty Acids

The approach followed was to attempt to obtain estimates of the quantity of essential fatty acids oils which are being marketed in North America. It was assumed that companies producing or having an interest in flaxseed oil, borage oil, sesame seed oil, pumpkin oil, sun oil etc. may be interested in sea buckthorn oils. Information was sought from a large number of sources that were felt to have a direct interest in this market. The following companies, government and private statistical agencies, associations, journals, industry magazines etc were contacted.

Canada Grains Council, Winnipeg, Manitoba

They were asked if they had information on the quantity of flaxseed especially organic flaxseed that is being marketed to companies producing flax oil. They were unable to provide any information or even a guess at what the sales of flax might be. They gave me the names of four companies processing and marketing flax oil, all in western Canada.

Saskatchewan Nutraceutical Network

Kelly Fitzpatrick who is the President of Neutrceutical Network in Saskatoon told me that she attempted a year ago, with little success, to provide an assessment of the essential fatty acid market in North America. She said that companies were not willing to provide information on their production or sales and statistical agencies did not collect this specific data. She was, however, helpful in providing other relevant information on sea buckthorn and essential fatty acids.

Size of Market-Based on Organic Flax Data

An article in the August/September issue of the Canadian Thistle, an organic magazine, stated that 77,000 bushels of organic flaxseed was produced in Canada.[3] This estimate was apparently provided by Wordstream Associate Publishing Support Services.

Based on discussions with companies in the US who produce organic flax oil it seems that they source a lot of their flaxseed in Western Canada. What percentage of US flax oil comes from Canadian sources is not known. One would suspect that given the low level of flaxseed production in the US it would be a high percentage.

This is not a great deal to go on but given the lack of any more reliable estimate this figure is used to provide at least some indication of how much organic flaxseed is being produced. There is also no evidence of how organic flaxseed is allocated. It can be assumed that organic flax is being used as whole seed in food products such as breads, muffins etc., taken as a laxative as well as used to produce flax oil.

If was entirely used to produce flax oil it would yield approximately 100,000 pounds (45,455 kgs) of oil. This is based on an expeller process where the oil yield would be about 35 percent.

What would be the demand for sea buckthorn seed oil if it could capture a share of this market? The important thing is to put this demand area in perspective. If sea buckthorn seed oil could capture 10 percent of the EFA market based on the figures above, it would be have a demand of 4,546 kgs of oil. Based on a yield of 5 tonnes of fresh berries per acre this would produce about 29-30 kgs of seed oil. It would, therefore, take only 150 acres of sea buckthorn to supply this demand—not a large amount.

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[3] This information was provided by John Opperman of Gold Top Organics. The exact reference was not located.

Consultant's Market Evaluation

Reese Moreman (see above) was asked what his estimate was for the size of the market for essential fatty acids. He said that he would place retail sales of flaxseed oil in the US at $25 million US.

The current retail price for flax oil in Saskatoon is about $12.00 for 500 ml. This translates into about $8.00 US. Using Moreman's estimate this would translate into about 1.6 million litres of flax oil. First, this is equal to about 3.2 million US gallons of oil assuming that the weight is similar to that of water. How much sea buckthorn would it take to supply this equivalent amount of flax oil?

Using a yield of 5 tonnes of sea buckthorn fresh berries per acre this produces 29 kgs of seed oil, or 64 pounds. It would, therefore, take about 50,000 acres of sea buckthorn to meet this demand. If sea buckthorn was able too capture even one percent of the market it would take 500 acres to meet the US demand.

The two estimates are thus quite far apart. A more accurate estimate would come from the actual sales figures of companies producing flax and other EFA oils for the North American market, a source we do not have.

Hartman and New Hope Study

The results from the Hartman and New Hope study show that consumers are interested in their essential fatty acid balance. The following are usage percentages by household. DHEA is being used by 3.4 percent, fish oil by 3.0 percent, flax oil by 1.0 percent and essential oil blends (EFA) by 0.8 percent, wheat germ oil by 0.7 percent, borage oil by 0.3 percent and hemp oil by 0.1 percent of all households. When summed it represents 7.8 percent of all US households taking an essential fatty acid.

I will focus on flax oil and attempt to illustrate what this means based on the above figure of 1.0 percent of households. First assume that the standard unit of purchase is a 500ml bottle of flax oil. Assume second that the normal daily dosage (as usually recommended) is one tablespoon per day. Since one tablespoon is equivalent to 14ml there is approximately 35 daily dosages per one 500 ml bottle. Since there is no information on how regular people are in taking flax oil, it will by subjectively assumed to be 5 times per week. Therefore one 500 ml bottle would last about 50 days. This translates into seven purchases per year. A market survey in Saskatoon showed that one 500 ml bottle of flax oil sells for about $12.00 ($8.00US). With one million households purchasing $56.00 of flax oil per year, the market would be $56 million US per year. This is higher that the $25 million estimated by Reese Moreman, the oil consultant.

This is equivalent to about 3.5 million litres of flax oil, or about 7 million pounds. How many acres of flaxseed would it take to provide this much oil? Assume that flax yields 25 bushels per acre and at a 35 percent extraction it would take approximately 14,300 acres to provide the 7 million pounds of oil for the US market.

What might the market be in ten years? Let's assume that the market grows similarly to that estimated for Kava Kava by Hartman and New Hope. The growth factor was about 20 times the base level. In that case the market for flax oil would be $1.1 billion US. At that this market size it would take about 280 thousand acres of flaxseed to provide this quantity of oil.

EFA Market Potential for Sea Buckthorn Oil?

Could sea buckthorn seed oil contest the EFA market? The analysis above shows that flax oil sells for about $24.00 Cdn ($16.00US) per litre. At present imported sea buckthorn seed oil sells for over $200 per litre. It does not appear that sea buckthorn would be able to penetrate the EFA market unless the price was reduced drastically. This still leaves the question of its substitutability regardless of price. This too is unknown and awaits tests to be carried out by manufacturers of EFA oils.

3.5 The Cosmetic and Toiletry Market

3.5.1 Sea Buckthorn Use in Sunscreens

As outlined in section 2.3.1 there is scientific evidence that fruit pulp oil has properties that can make it potentially useful in sunscreen preparations.

Market analysis

Cosmetech Laboratories is a private laboratory which tests various products for clients for use in the cosmetic industry, which includes the manufacture of sunscreen products. (see references) Information was obtained from the President. Mr. Kenneth Klein. He holds a MS in Chemistry and has been in the cosmetics industry for 30 years which included seven years at Lever Brothers. He is a Fellow of the Society of Chemists and of the American Institute of Chemists. He is an Adjunct Professor at Fairleigh Dickinson University and is an instructor for the Society of Cosmetic Chemists. He holds several patents and has authored chapter on sunscreen formulations published by Marcel Decker.

He was asked if he had data on the size of the sunscreen market? He stated that there is not good data that he was aware of but estimated the market as follows;

United States	$500 million annual sales
Europe	$500 million annual sales
Australia	$100 million annual sales
Canada	$50 million annual sales

He was asked what Associations represent the sunscreen industry? He said that there is no specific Association for sunscreen products. In the US sunscreen chemists and companies would be affiliated with the Cosmetic, Facial and Toiletries, Association (CFTA) and the Society of Cosmetic Chemists. In Canada it would be the Canadian Cosmetic, Facial and Toiletries Association (CCFTA)

He was next asked, what are the major ingredients for the manufacture of sunscreen products? He said that in the United States there are essentially 16 product ingredients which have been approved for use in sunscreen manufacture. All but two of these ingredients are synthetically derived. The main one is octylmethoxycynnanle. The two not synthetically derived are zinc oxide and titanium oxide.

If sea buckthorn has any possibility of being used in sunscreen manufacture it will depend in part if there are regulations. Klein said that the market is regulated by the US Food and Drug Agency.

When asked if he was familiar with the commodity sea buckthorn he said that in fact I suspect we have some material in our laboratory which we have tested for a client. He did not say that this was specifically for sunscreen. I suspect that it was not and the testing was done for other cosmetic products.

I said that the literature on sea buckthorn suggests that sea buckthorn oil is a good candidate for use in sunscreen manufacture. I asked what is the likelihood of this happening? His answer was that there is currently no use being made of any natural product in sunscreen products to his knowledge. Several large companies have attempted to obtain approval for the use of natural substances that have UV absorption capabilities. None have been successful. here are several reasons for this.

First, there is the limitation of natural material to absorb UV rays. Materials should absorb at 310 nanimeters. What matters is concentration. Synthetic materials have several thousand times the concentration of particles to absorb UV rays. Second is the lack of a reason for the FTA to approve any new material. He said that the existing 16 approved ingredients are working well in preparing sunscreens

so why go through the process of testing others. Third, is the cost of having the testing done. The cost would run into the millions of dollars and may take up to 15 years.

3.5.2 Facial and Hair Cosmetics

In the literature as outlined earlier there are claims for the use of sea buckthorn pulp oil in cosmetics. "The practical efficacy on 350 patients in Guandong Provincial People's Hospital and Guangdong Provincial Institute of Medicine was observed, and the result showed that sea buckthorn beauty cream had positive therapeutic effects on xanthopsis, melanosis, senile plaque, palm skin rhadages, xeroderma, faced-acne, recurrent dermatitis, chemical corrosion, and ichthyosis, as well as freckles." (ICIMOD). The same publication also talks about products with sea buckthorn extracts improving metabolism and retard skin maturation.

Cometech Laboratories also test products for the cosmetics and assist companies in developing new cosmetic products. They were asked if they knew the size of the US cosmetic industry. Klein said that, he would estimate the market for facial cosmetics alone at approximately one billion dollars US.

He was asked for his opinion onwhehter sea buckthorn oils have a potential use in the cosmetics industry? He said that there is a large use of natural oils in the cosmetics industry and for this reason sea buckthorn should be able to establish a use and thus demand.

He was next asked what would it take to test a sea buckthorn product in your laboratories? He said that it is a two phase process. Firs, is to test it's the material's applicability and this would cost approximately $5,000US Second, is to develop a series of formulations and this would cost approximately $20,000US.

He was asked, what happens following testing and how is a market developed, for example, how would one interest a large company like Estee Lauder? He said that one would have to bring them "a package." You would have to show how the sea buckthorn product in this case is used in formulation of a final cosmetic product(s). There would have to be safety testing carried out.

Aubrey Organics

This company with headquarters in Florida was founded in 1967. The company claims that it was the first skin care company (in the US?) to develop a grapefruit seed extract and antioxidant preservative (in 1974). It was the first to to formulate products with essential fatty acids and to utilize such herbs as jojoba oil, evening primrose oil, Rose Hip seed oil, blue camomile oil. They claim to be the first cosmetic company to be certified organic. They state that they obtain herbs from around the world, "hundreds-and-hundreds of them"

The company is of interest because it uses sea buckthorn in some of its products. It boldly uses sea buckthorn on its labels thus promoting the use of sea buckthorn.

The company's web site suggests that they produce 130 different products. However, the contact Karyn Trumbach said that they produce over 200 products. Aubrey Organics manufactures products that fall into the following product categories: baby care, bath products, hair care, pet care, skin care, sun care, hand and body lotions, cologne, household, makeup men's stock and moisturizers. Of the categories sea buckthorn appears in: bath products, (1 item), hand and body lotions (1 item) and skin care (3 items) (see Appendix A for details on these five products by Aubrey Organics).

There are 4500 outlets around the world that carry Aubrey Organics products. In Western Canada there are six listed outlets in Edmonton, a similar number in Calgary, one in Winnipeg but none in Saskatchewan.

The production manager said that they use a blend of sea buckthorn seed and pulp oils, but the actual ratio was not stipulated. They currently source their oil from Siberia. They currently use only 100 kilos of sea buckthorn oil per year.

Ms Trumbach said that currently their sea buckthorn shampoos and conditioners are selling well, better than the facial cream. The facial cream is bright yellow in colour due to the carotenoids. This is a problem for fair skinned people she said.

The plant manager was not able to make a forecast for sales of sea buckthorn products for the next 5 to 10 years. He said that it was too early to tell since they have only recently introduced their sea buckthorn products.

Dr. Temt Laboratories, Vienna, Austria

This company claims to have produced skin care products for over 50 years. They appear to focus on natural products but do not claim to be organic. They produce a wide range of products including cleansers, lotions, peelings, essential oils, creams, eye treatment, massage, masks, hand and foot treatments, sun care and body treatment products. In August of this year they introduced products containing sea buckthorn.

In the US the company uses the distributor Pauli of Vienna, located in Boca Raton, Florida. They have been selling this product line for 15 years in North America. The contact, Brigitte, said that the new sea buckthorn products were "doing very well". They have more than 3,000 outlets in the United States.

In Canada Cosmetics Based on Nature Inc. is the exclusive distributor for Dr. Temt products. They are located in Toronto.

3.6 Sea Buckthorn Powder

Very little information was obtained on the market for sea buckthorn powder. No companies were contacted to determine their interest in using the product because of the limited information available on the specifications of the powder.

Prairie Sun Grains was owned by Agricore, with headquarters in Calgary. In July, 2000 this company (or division) was sold. The new owner is Pat Maloney. My understanding is that the mill from which products are manufactured is in Camrose, Alberta.

The company is now called Prairie Sun Grains 2000 Inc. Prairie Sun Grains was manufacturing an energy bar that contained sea buckthorn as an ingredient. This bar was called Prairie Sun Cardio Nutrition Bar. Because it contained the work "cardio" it could not be marketed in Canada, although it could be marketed in the United States. Prairie Sun Grains did not purchase the rights to the energy bar. The new company is exclusively a company manufacturing grain products.

In Canada they market Sunny Boy cereal. In the US this is called Prairie Sun. One product is called Hot Quick Cooking Herbal Supplement. This product is sold as 10 packets where each packet is sufficient for one serving. Each package is 39 grams of which 100 mg are sea buckthorn. This means that there is 390 grams per package containing 1000 mg. Therefore, sea buckthorn makes up only 0.26 percent.

The package only sold in the United States sells for approximately $5.00 US. This means that the value component of sea buckthorn is about $1.3 cents.

The amount of sea buckthorn in the energy bar, according to the label, was at a comparable level, less than one percent.

3.7 Cases

The purpose of this section is to present industry cases that can provide some form of validity for the establishment of a sea buckthorn industry in Saskatchewan(Canada). The assumption is made that companies set up to process sea buckthorn would not do this if it weren't economically feasible.

Case 1. Hilary Rodriques, Markland Cottage Winery, Whitbourne, Newfoundland

The presentation of this case is based primarily on a discussion with Hilary Rodrigues, of Markland Cottage Winery. This operation produces 15,000 cases of fruit wines per year.

The company has decided to branch into the processing of sea buckthorn fruit. They will have a 8,000sq ft. plant to process the fruit. They expect the plant to be able to process annually six million pounds of fruit in one eight hour shift (6 hours of actual processing)

They plan to produce juice, seed and pulp oils and powders. The fruit will be first crushed using a rubber crusher. The crushed fruit will be placed in a tank and treated with enzymes to break down the material to prepare it for further processing. The material will be put through a press. Seeds will be separated. The material will be centrifuged to obtain pulp oil. The remaining pulp will be spray dried to produce a powder. Both oils and juice will be pasteurized. The juice will be altered using iceberg water to bring it down to a state where it can be consumed.

It seems that they plan to manufacture some products and also sell some of the semi-processed products to other enterprises for manufacture. They plan to market pure sea buckthorn drinks as well as blended products. They will look at blending wild cranberry, pear, peach, strawberry and raspberry. The powder will find uses, for example in granola type bars.

Initially they will import containers of sea buckthorn fruit from Russia (Siberia). They have a working relationship with three research institutes in Siberia who have been working on sea buckthorn for 35 years. There is now a small number of acres planted to sea buckthorn in Newfoundland. They are contracting with local land owners to grow sea buckthorn. Their target is to have 400 acres by 2005. If the yield is five tonnes per acre this would provide about 4.5 million pounds of fruit, or 75 percent of their requirements. They will guarantee to buy all sea buckthorn at the world market price.

They hope to be able to mechanically harvest the fruit although this has not been worked out. From the discussion it appears that it is more difficult to remove the berries from the stems of the thornless varieties. It is estimated that one person can hand-pick 100 kilos per day. Labour cost was placed at $0.50 per pound.

Mr. Rodrigues is particular on which cultivars are grown. At present the cultivars come from Siberia; they are all thornless types. He provides two year old plants for the growers at $10 per plant. He said these cultivars are higher yielding and the fruit has higher concentrations of vitamin C the variety Senensis.

He talked about the aspects of sea buckthorn which makes it such an appealing commodity. He referred to the use of seed oil in treating radiation burns partly because of its ability to penetrate the skin. He said that the generic forms of material used to treat the skin require catalyst but sea buckthorn has these ingredients already in it. However, there is limited research to precisely document what phytochemical process is at work to provide this benefit.

He felt that the markets are better developed in Europe and in South East Asia where there is knowledge of sea buckthorn. In these markets people are more used to herbal products. He expects to market some of his products there. He spoke of the large North American demand for juices. He felt that sea buckthorn could be competitive with orange juice basing this on the yield profile of sea buckthorn in comparison with oranges.

He hopes to pioneer a whole new wave of products. He feels that the ethnic origins of Russian, Ukrainian, Scandinavian and Finnish people will provide a base for demand in North America.

The goal is be organic and growers are being encouraged to comply with organic standards.

Prices were discussed. He said that seed oil was selling for $280.00 CDN per kilo and pulp oil at $250.00 CDN per kilo. Cosmetics was felt to be the main price setter. The market price for top quality sea buckthorn fruit is $2.00 per pound delivered at his plant. One aspect of good quality is fruit which is not frozen prior to harvest. He said that thawing and freezing before harvest lowers the quality in terms of ingredients. However, once they are harvested the fruit can be frozen.

Case 2 Allen Smith, Altex, Vernon, British Columbia

At the other end of Canada from Newfoundland is the company Altex. This company which was incorporated three years ago It was established by Allen Smith and one partner. It currently markets herbal products.

Mr. Allen became interested in sea buckthorn several years ago. He has been working with Tom Beveridge and Dave Oomah with the Agri-Food Research Centre, Agriculture and Agri-Food Canada, Summerland, British Columbia. They have been carrying out analysis on sea buckthorn and working to develop processing technology. He has also engaged Phillip Sigmund who is a chemical engineer to develop the appropriate processing technology. Mr. Sigmund is now located in Calgary and his operation is Hypex Extraction. They have been concentrating on C02 super critical extraction.

The next stage of their work is to process products in six product areas for industry testing. They are seeking support from the Alberta government to undertake the processing, the industry product assessment and the economic feasibility analysis. The fruit is already available. It will come from Summerland. It consists primarily of the variety Indian Summer. They are hoping to have the funding in place early in 2001 if their application for funding is successful and have products available for testing by mid summer. It is seen as a three year project.

Mr. Allen has been instrumental in establishing a sea buckthorn growers association in British Columbia. There are about forty members. The purpose of the organization is to provide a base to spearhead industry development. It would provide information to growers, would take the initiative in registering any chemicals needed for production, lobbying for agronomic research, and others.

He said that they he has not investigated the market for sea buckthorn products or attempted to assess the interest of industry players in the various product areas. He did not have any information to share on companies with interest in sea buckthorn, although he had communicated with Aubrey Organics. He mentioned the possible interest of Sunripe who have a plant in Kelowna.

Case 3 Colin McLoughlin,Canada Sea Buckthorn Enterprises Ltd.

Mr. Colin McLoughlin has been instrumental in developing Canada Sea Buckthorn Enterprises Ltd. (CSEL) Information on the company is contained in the web site—www.seabuckthorn.com. It is stated that CSeL was incorporated in BC and Saskatchewan in the early 1990s. It states further that the first efforts were to carry out "missionary work" to provide information and education on sea buckthorn as it is largely unknown in North America. Quoting the site, "CSEL is continuing its developmental work in Saskatchewan and Manitoba. We are maintaining our steady progress toward our goal of 1000 acres of sea buckthorn plantations in Canada through a combination of contract growers and company plantations. Construction of a sea buckthorn processing plant is on target for 2001."

To date it seems that CSEL has focused on importing sea buckthorn products primarily from China to for sale in North America. Although the exact acreage is not known CSEL has been instrumental in the planting of several hundreds of acres in Manitoba and Saskatchewan. The company has apparently

purchased (or taken an option) on a building in Wynyard, Saskatchewan for the processing operation. Unfortunately little more is known at this time about when the plant will be developed.

As explained earlier Mr. McLoughlin was very helpful in sharing the results of a study by Hartman and New Hope on the market for neutraceuticals with specific estimates for the market for sea buckthorn tea.

CHAPTER 4

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

4.1 Summary

The purpose of this study was to investigate the markets for sea buckthorn, that is the components of the sea buckthorn plant, the oils, juice, leaves etc.

It is important to stress that carrying out a market analysis for any commodity which essentially has not established much of a presence like sea buckthorn is very difficult. This was anticipated at the outset. Sea buckthorn is not an established crop in North America and there is still a very limited use being made for sea buckthorn components in consumer level end products.

The methodology (approach to study) was laid out in Chapter 1. The approach was essentially to investigate each market segment where sea buckthorn components have established a use or have a potential use. The study had to largely rely on the willingness of existing users to provide information or rely upon those not familiar with sea buckthorn to provide an assessment of its potential use and thus demand based on a cursory evaluation of component specifications. The study was also based on what information is currently available in the literature on sea buckthorn use and the use of components that have similar properties to sea buckthorn.

This methodology provided mixed results. The market and marketing literature is very weak on sea buckthorn and its products, especially when it comes to North America. What is available largely pertains to product use in China, Russia and Europe. This is of some value as it establishes that sea buckthorn has proven its ability to penetrate these markets. While this provides a basis to investigate these markets this analysis was seen to be beyond the scope of this particular study. Since market conditions can be very different between Europe, Asia and North America this information one must be careful in drawing inferences.

The study attempted to obtain information on companies that manufacture consumer products in each of the various market segments in which sea buckthorn has potential: cosmetics, essential fatty acids, health beverage, teas, etc. Many of the sources were obtained from the internet while other sources were based on suggestions from people working in sea buckthorn and/or other areas of the nutraceutical and functional food markets.

For companies most of the contacts made were as helpful as they could be, that is, they seemed forthright in providing what information they had. However, certain companies and individuals were not willing to depart with information on their operations and in particular information on their markets. Some were not willing to provide even an assessment of the general market for which their products fit, either because they were not willing to depart with this information or they did not know. In most cases I suspect that the problem is the latter. If the industry through an Association or Council was representative of the majority of the processing companies they would have information through sales or production information from their members. There does not appear to be an organization of this nature.

4.2 Conclusions

Conclusions #1 General Conclusion on Markets for Sea Buckthorn

The literature on the use of sea buckthorn in China, Russia and Europe support a general conclusion that markets for sea buckthorn have been established. There is a significant area devoted to sea buckthorn in China and Russia which would indicate that there was a demand for sea buckthorn fruit, however, the literature did not reveal data on the quantity of sea buckthorn fruit produced nor quantities of products made from sea buckthorn. None of the sources provided sales figures.

Because there is a great interest in Chinese herbal medicines and alternative medicines amongst the North American population the fact that sea buckthorn has established itself in China should lend support to its adoption and use in Canada and the United States.

Mr. Hilary Rodrigues, of Markland Cottage Winery in Newfoundland, who is currently in the process of constructing a plant to process sea buckthorn, said that the best markets were currently in South East Asia and in Europe. It seems that he will be looking to these markets for his sea buckthorn products once he is in production.

Two other companies, Altex and Canada Sea Buckthorn Enterprises, both located in British Columbia, are working towards establishing processing operations. However, they do not seem to be as advanced as the operation in Newfoundland.

Conclusion #2 Essential Fatty Acid Market Possibilities for Sea Buckthorn Oil

The essential fatty acid market (EFA) which comprises linolenic and linoleic acids is growing. The North American public are becoming educated in the need for a better balance between linolenic and linoleic fatty acids. In order to correct this imbalance consumers will need to begin to increase their consumption of oils rich in linolenic fatty acid. At present this tends to favour flax oil which has over 50 percent linolenic acid. Sea buckthorn seed oil which contains about 30 + percent linolenic acid would appear to a product which could enter this market.

A number of companies producing organic flax and other oils were contacted. These companies were primarily located in Western Canada and the Western US. Only one company had heard of sea buckthorn. One company located in the United States engages a consultant who claimed to be familiar with sea buckthorn. He did not offer much hope that sea buckthorn could penetrate this market. His major reason was in the processing requirement to produce an oil that was stable. This requires special processing that is used by the industry producing flax and other oils. Whether sea buckthorn could be processed to meet the requirements for EFA products is not known.

Although the demand for essential fatty acids (EFA) is large and growing it is unlikely that sea buckthorn can penetrate this market at present. None of the several major producers of organic fatty acids such as flax, borage, sesame had tested sea buckthorn oils. Only one company contacted had even heard of it. A North American consultant in the EFA market claimed to have examined sea buckthorn oil and he felt it had no special features that would give it a place in this market.

The main issue is price. Sea buckthorn oil at present is not price competitive with other natural oils in this market. Flaxseed can be used as an example. A yield of 25 bushel per acre produces approximately 490 pounds of flax oil. At present flaxseed sells for $200 per tonne, however, organic flaxseed would be somewhat higher. One tonne of seed would produce approximately 770 pounds of oil, or $0.26 per pound. Since there is no public information on the cost of processing sea buckthorn it is not possible to work out the cost of a pound of oil. If there is about two pounds of oil per litre then one litre would be worth about $0.50 at the farm level. If one acre of sea buckthorn can produce 5 tonnes of fresh berries per acre this would yield about 30 kgs of seed oil. If one litre is equivalent to one kg then at the price of flax sea buckthorn would be worth about $15. At the present price of sea buckthorn of $200 per litre the oil would be worth $6000 per acre less marketing and processing costs.

The other way of examining this is to work from the price of organic flax oil as sold in health food stores. At the retail level 500 ml of flax oil sells for approximately $12.00.CDN, therefore one litre would sell for $24.00 CDN. At 30 kgs per acre this would be $720 per acre at a retail equivalent. This is significantly lower than the current $6000 per acre at wholesale for sea buckthorn seed oil.

Conclusion #3 Market for Sea Buckthorn Juice

There is a large and growing g market for juices that contain various supplements. Given that sea buckthorn contains many of the nutrients in high levels which are sought after by consumers there should be a good market for sea buckthorn as a straight or blended juice depending on cost. This is one of the products that Markland Cottage Winery is planning on producing when it begins operation which suggests that this company feels that it can manufacture products with sea buckthorn and be competitive.

By itself simple analysis shows that sea buckthorn does not produce sufficient juice per acre to be potentially competitive with Florida orange juice if sea buckthorn juice could not be sold at a significant premium to standard orange juice. There is the additional problem of harvesting and marketing costs. If orange s can be harvested and processed much cheaper than sea buckthorn it will have an added advantage in the juice market. The estimated harvesting costs for Florida oranges are currently $1.80 to $1.90 US per box (90 pounds of oranges) and processing costs are between $0.15 and $0.25 per gallon of orange juice. There is no available public information on processing cost of sea buckthorn for comparison purposes.

If sea buckthorn juice were to be sold at a comparable price to orange juice at retail it would be worth approximately $240 from sea buckthorn yielding five tonnes per acre. Assuming for simplicity that processing and marketing costs were half the retail value this would leave $120 to the producer for the juice portion of the fruit.

This study was not able to locate any useful material in the literature on this market to assess size of the functional food beverage market.

Conclusion # 4 Market for Sea Buckthorn in Sunscreen Products

It is unlikely, based on this discussion and assessment by Mr. Ken Klein and David Steinberg of Cosmotech Laboraties that there is a market for seabuckthorn oil for use as the main UV absorbing agent in the manufacture of sunscreen products in the United States. This is based on the fact that sea buckthorn seed oil has protection properties against UV –B and not UV-A. It is also based on the assessment that natural fatty acids do not have the same ability to absorb UV rays as do several synthetic compounds. However, there are cosmetic companies who sell and advertise that they sell "natural" sunscreen products. This study has not determined how effective these sunscreen products are in comparison to sunscreen products that include synthetic screening agents.

Conclusion #5 Market for Cosmetics

The North American market for cosmetics is large and is growing. There is also a growing demand for cosmetics which are natural or organic. This should offer opportunities for sea buckthorn.

This is one market area where sea buckthorn has established a demand in North America. One company, Aubrey Organics has developed six cosmetic products using sea buckthorn. These products were only introduced in the last two years, therefore, there is insufficient information to make any general assessment of future demand. This company currently uses only 100 litres of blended seed and pulp oil. The sea buckthorn content in their products appears to be quite low.

A company located in Vienna, Austria uses sea buckthorn in its product line. The company, Dr Temt is exporting to both Canada and the United States through agents. There is information from these importers on their sales to date.

One can draw a tentative conclusion that cosmetics offers a good prospect for sea buckthorn oils in future but what the actual demand will be is difficult to determine at present.

Conclusion #6 Market for Leaves

The market for sea buckthorn teas and extracts shows a great deal of promise. The market for herbal tea market is growing in the United States and thus should also be growing in Canada. Hartman and New Hope, in a study carried out for Canada Sea Buckthorn Enterprises, estimated the market for sea buckthorn tea to be $2.2 million US in year one of their analysis to increase to $18.4 million US in ten years. The study was done in 1998. The Hartman and New Hope study estimated that 13.7 million US households could be consuming sea buckthorn tea.

Lack of information on the production level of leaves and quantity of leaves required for a unit of saleable sea buckthorn tea prevents an estimate of the acreage of sea buckthorn required for this market.

Conclusion #7 Market for Powder

Given the limited analysis carried out it is not possible to draw any conclusion s about the market(s) for and the market demand for sea buckthorn powder.

The one company using sea buckthorn powder did not have good specifications for the powder. It is unwise to translate the specifications on sea buckthorn juice to the powder. There could be loss of vitamins and the proteins could be denatured in when the juice is heated in pasteurization and spray drying. For this reason it was not possible to contact companies who could potentially use the product, such as manufacturers of cooking cereals, bakeries, snack bars etc.

Conclusion #8 General Conclusion

The development of the sea buckthorn in the Prairie provinces is approaching a critical point. There is an estimated 550 acres that have been planted to sea buckthorn, mostly in Saskatchewan and Manitoba. All of this acreage should be in production in three years. Assuming a potential yield of 5 tonnes per acre this would translate into 2,750 tonnes or approximately 6 million pounds of fruit. The highest percentage of this fruit will have to undergo primary processing if it is to have a market.

At present there is only one potential investor for the construction of a sea buckthorn processing plant in the Prairies. Should, for whatever reason, this plant not be constructed and operated the producers who have invested in the establishment of sea buckthorn orchards and shelterbelts will essentially have no market for their sea buckthorn fruit.

The sea buckthorn processing plant being developed in Newfoundland will according to its developer, Mr. Hilary Rodriques, utilize approximately six million pounds of fruit per year. This is about the exact quantity that may be produced on the Prairies at current plantings.

The situation needs to be carefully monitored in 2001 to determine if a processing operation is going to be developed by a private investor. If this is not going to happen producers will have to look to some alternative, such as looking for a new private investor, a market outside of the Prairies, or investing in a processing plant themselves.

Those in the federal and provincial government who are contributing to the development of sea buckthorn should assist in this process.
Additional research is needed to provide the information needed for this purpose. (seerecommendations below).

4.3 Recommendations

Recommendation #1 Product testing and market analysis

Given that sea buckthorn is a generally unknown commodity in North America it is difficult to assess demand. The procedure followed in this study which was to send specifications on sea buckthorn constituents to prospective processors buyers, that is potential users of sea buckthorn, had limitations. In some cases the company was able to make an assessment of the potential use of the sea buckthorn product but in many cases the company said that there was not sufficient information on the sea buckthorn product to make an assessment.

The most effective method for assessing the interest in sea buckthorn and hence market demand is to be able to send a sample of the sea buckthorn product to a prospective buyer (user) for testing.

Given that there could be differences in the sea buckthorn product depending on where it was grown it would be important that the product come from sea buckthorn fruit grown in Saskatchewan (Prairies). It would also be important to have the test done on the cultivar that provided the fruit with the highest level of the constituent of usefulness to the buyer.

It is important that this type of testing be carried out as soon as possible. It is also important that the test results are public information, particularly where government is providing the financial support for this analysis.

Recommendation #2 Market analysis

The market research which was undertaken in this study should continue. It will be greatly aided by information obtained from product testing as recommended above.

Recommendation #3 Cultivar selection

Plant breeders of new sea buckthorn cultivars must have information on which sea buckthorn constituents to select for. It is critically important to determine which constituents will provide the highest economic value, whether this is seed oil, pulp oil, juice, juice powder, animal feed etc.

This need is further support for recommendation #1.

Recommendation #4 Industry development – producer organization

An organization of sea buckthorn producers will be important to the future development of the sea buckthorn industry. This organization should be Prairie based, and possibly Western Canadian based. Organized producers have the ability to lobby for government support for research and development of the industry in a more effective manner than individual producers or processors. They can also can provide information to new growers and act as a industry development vehicle. This is the first step to the eventual formation of a Sea Buckhtorn Council should the sea buckthorn prove to have the economic potential for full industry development. The Canola Council and the Flax Councils of Canada are just two examples of councils that have been instrumental in the development of these two commodities.

The federal and provincial governments should provide support to sea buckthorn producers who take the leadership in forming such an organization.

Recommendation #5 Industry development-cost analysis of alternative processing technologies

There is no publicly available information on the costs of processing sea buckthorn fruit. This information is important to potential investors in the industry and in particular producers who are considering integrating forward into primary and/or secondary processing. This information is also

important to assessing individual and industry viability. The analysis should include the alternative methods of processing such as CO^2 or hexane extraction as well as cold pressing technologies.

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Discussions

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